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Orwellium, a new Valdivian genus of Platygastridae (Hymenoptera)

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Abstract

Orwellium enigmaticum is described as a new genus and species. This species is endemic to the Valdivian forests of Chile. The genus is hypothesized to be the sister-group of the subfamily Platygastrinae *sensu lato* (i.e., including both Platygastrinae and Sceliotrachelinae).

Keywords

parasitoid wasp, systematics

Introduction

The parasitoid wasp superfamily Platygastroidea traditionally has been divided into two families, the Platygastridae and the Scelionidae (e.g., Masner 1993, 1995; Austin et al. 2005). Both groups are found worldwide, with the exception of Antarctica. All scelionids, as far as is known, are idiobiont egg parasitoids, attacking hosts in a range of insect orders as well as spiders. A small number of genera of Platygastridae are also egg parasitoids, a few are known to attack nymphal Sternorrhyncha, but the vast majority

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of host records for species in the family are koinobiont egg-larval or larval parasitoids of gall flies (Diptera: Cecidomyiidae) (Austin et al. 2005).

The formal classification implied that these families represent two distinct lineages. However, a recent analysis of relationships within the superfamily (Murphy et al. 2007) based on sequence data from three genes – 18S rRNA, 28S rRNA, and cytochrome oxidase I – came to the tentative conclusion that the platygastrids were nested as a monophyletic group within Scelionidae, thus rendering the latter paraphyletic. The details of the intergeneric relationships varied depending upon the analysis used, and low levels of support were found for many of the deeper nodes. Additionally, the analysis included representatives of only 58 genera, less than one fourth of the number of genera currently recognized to be valid within the superfamily. On the basis of these considerations, no changes were proposed in the classification. Sharkey (2007), however, apparently considered this evidence and analysis to be sufficient for he formally placed the family Scelionidae Haliday, 1839 as a junior synonym of Platygastridae Haliday, 1833. Sharkey (2007) made no mention of the status of the five subfamilies within the two former families. Thus, in clearing up the classification by eliminating one putatively paraphyletic taxon, the internal classification of Platygastridae *sensu lato* was rendered even more uncertain. Presumably, the monophyletic Platygastridae *sensu stricto* should be treated as a single subfamily. In lieu of concrete and well-supported hypotheses of relationship, for the purposes of this paper we will continue to treat the three scelionid subfamilies – Scelioninae, Teleasinae, and Telenominae – as valid taxonomic units. Thus, the family Platygastridae will be considered to contain four subfamilies.

The Platygastrinae have long been recognized as a discrete unit. This is evident not only in sequence data, but by a number of morphological characters. The number of antennomeres is reduced to a maximum of 10; the sex-segment in the male antenna is found on A4 or rarely on A3; cerci are absent; the second metasomal segment is significantly larger than all others; the netrion is lacking and the second flexor of the fore wing arises on the mesopleuron (Mikó et al. 2007); and the fore wing tracheate veins are strongly reduced to, at a maximum, only a single truncated R. These are largely reductional characters that are also observed in genera of other subfamilies. The combination of characters, however, and the predominant use of cecidomyiids as hosts, has generally been adequate to define the group for the past 170 years.

In the analysis of Murphy et al. (2007) the sister group of Platygastrinae is not conclusively identified. The genera *Archaeoteleia* Masner and *Neuroscelio* Dodd are basal to all other platygastroids in both the maximum parsimony and Bayesian analyses. In the latter, the next branching point is an unresolved polytomy comprised of the branch leading to the platygastrines, the genera *Sparasion* Latreille and *Sceliomorpha* Ashmead, and the monophyletic group composed of all of the remaining genera. In the maximum parsimony analysis, *Sparasion* groups together with *Archaeoteleia* and *Neuroscelio*. None of these potential sister taxa is intuitively obvious. In general, individuals in these genera are large in body size, coarsely sculptured, and characterized by having higher values in meristic characters (such as the number of sex segments in the male antenna). Platygastrines, in contrast, are uniformly small to minute, finely sculptured, and char-

acterized by reductions in most meristic characters. Thus, the subfamily appears to stand apart as a morphological and biological outlier.

The platygastroid fauna of southern Chile has both a number of unique elements as well as others that are consistent with transantarctic distributional patterns. The genera *Romilius* Walker, *Almargella* Masner & Huggert, *Magellanium* Masner & Huggert, and *Nanomerus* Masner & Huggert are unique to Chile (Masner and Huggert 1989; unpublished data); *Proplatygaster* Kieffer is found in Chile and Australia (Masner and Huggert 1989); *Archaeoteleia* is known only from Chile and New Zealand (Early et al. 2007). Whether such patterns represent vicariant events, widespread extinction, long-range dispersal, or simply inadequate sampling is unknown. However, the oldest known fossils are in Lebanese amber dated 112–122 mya (Johnson et al. 2008c); thus, the age of the superfamily is at least consistent with the possibility of vicariance.

Among recent collections from Valdivian forest in Chile, one of us (L. Masner) discovered numerous specimens of an enigmatic platygastroid, puzzling in that it seemed to fit well in neither the Scelionidae nor the Platygastridae. The purpose of this paper is to describe this species, placing it in a new genus and species, and to discuss its possible position within the superfamily Platygastroidea.

Material and methods

This work is based upon specimens in the following collections, with abbreviations used in the text: CNCI[1], Canadian National Collection of Insects, Ottawa, Canada; OSUC[2], C.A. Triplehorn Insect Collection, Columbus, OH.

Abbreviations and morphological terms used in text: A1, A2, ... A10: antennomere 1, 2, ...10; claval formula: distribution of the large, multiporous gustatory sensilla on the underside of apical antennomeres of the female, with segment interval specified followed by the number of sensilla per segment (Bin 1981); MGS: multiporous gustatory sensilla, located on ventral surface of apical antennomeres of the female; OOL: ocular ocellar line, the shortest distance between the inner orbit and the outer margin of the lateral ocellus (Masner 1980); Shape criterion: definition of clava on the basis of the shape in which the apical surface of the proximal antennomere is parallel to the basal surface of the following antennomere; T1, T2, ... T7: metasomal tergite 1, 2, ... 7; S2: metasomal sternite 2. Morphological terminology follows Masner (1980) and Mikó et al. (2007).

In the Material Examined the numbers prefixed with "OSUC" are unique identifiers for the individual specimens. Since the label data for all specimens have been georeferenced and recorded in the Hymenoptera On-Line database, details on the data associated with these specimens can be accessed at the following link: http://purl.oclc.org/NET/hymenoptera/hol, by entering the identifier in the form. Note the space between the acronym and the number. Data for the genus can be accessed at http://purl.oclc.org/NET/hymenoptera/hol?id=238175. The description was generated using a database application, vSysLab, designed to facilitate the production of a taxon by character data matrix, and to integrate this with the existing taxonomic and specimen-level

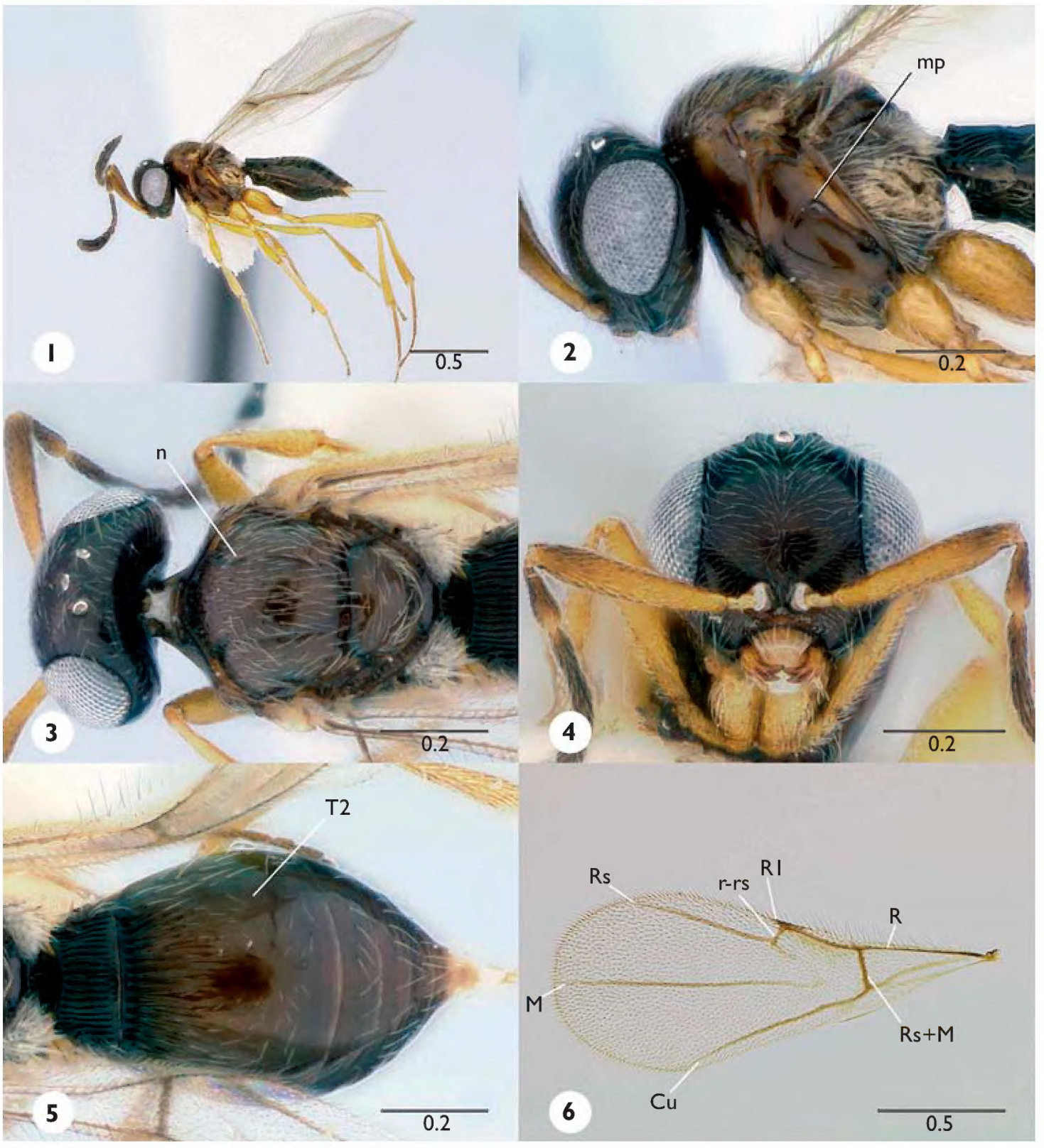
database. The text output for descriptions is in the format of "Character: Character state(s)." Images and measurements were made using AutoMontage and Cartograph extended-focus software, using JVC KY-F75U digital cameras, Leica Z16 APOA microscopes, and 1X objective lens. Images are archived at Specimage, the image database at the C.A. Triplehorn Insect Collection, and Morphbank. New taxa have been prospectively registered with Zoobank (Polaszek et al. 2005). Biodiversity informatics standards are implemented following Pyle et al. (2008) and Johnson et al. (2008a). External hyperlinks from the text are explicitly cited in the footnotes so that users of the printed version of this paper have access to the same resources. Life sciences identifiers, LSIDs, may be resolved at the specified URLs or at http://lsid.tdwg.org.

***Orwellium enigmaticum* Johnson, Masner & Musetti, gen.n., sp. n.**
urn:lsid:zoobank.org:act:001233E8-5447-40C3-9F1E-0F6F19BFC044
urn:lsid:zoobank.org:act:77F632EF-5DB9-43C2-A695-5D0D9A564FD0
urn:lsid:biosci.ohio-state.edu:osuc_concepts:238175
urn:lsid:biosci.ohio-state.edu:osuc_concepts:245120
Figures 1–6; Morphbank[3]

Description. Body length: 1.28–1.51 mm (n=20). Head color, female: brown to dark brown. Head color, male: brown to dark brown. Mesosoma color, female: brown to dark brown. Mesosoma color, male: brown to dark brown. Metasoma color, female: brown to dark brown. Metasoma color, male: brown to dark brown. Body shape: small, compact.

Head: Head shape, dorsal view: transverse. Hyperoccipital carina: absent. Occipital carina, extent: complete medially. Occipital carina, sculpture: simple. Position of lateral ocellus: remote from inner orbit, OOL > 2 ocellar diameters. Length of LOL: less than POL, less than OOL. Eye setae: glabrous. Frontal scrobe: frons convex, frontal scrobe not developed. Course of inner orbits: nearly parallel, diverging only at ventral extreme. Central keel: absent. Submedian carina: absent. Orbital carina: absent. Fan of striae arising from anterior mandibular articulation: absent. Clypeus structure: divided transversely to form anteclypeus, postclypeus. Clypeus shape: unknown. Anteclypeus shape: large, semicircular, concave. Postclypeus shape: short, strongly transverse. Apical margin of clypeus: straight. Lateral corners of clypeus: not produced, confluent with oral margin. Malar sulcus: present, fine, deeply incised, J-shaped. Genal carina: absent. Mandibular tooth orientation: transverse. Mandibular dentition: identate. Number of maxillary palpomeres: 2. Shape of penultimate maxillary palpomere: cylindrical. Number of labial palpomeres: 1. Number of antennomeres, female: 10. Number of antennomeres, male: 11. Insertion of radicle: parallel to long axis of A1. Dorsal surface A2, female: rounded. Length of A3, female: distinctly greater than length of A2. Claval formula: A7-A10/2-2-2-1. Number of clavomeres, shape criterion: Number of clavomeres, MGS criterion: 4. Number of MGS on basal clavomere: 2. Orientation of MGS: longitudinal. 5. Tyloid-bearing antennomeres, male: A5 only.

Mesosoma: Transverse pronotal carina: absent. Mesosoma length: subequal to height, mesosoma normally proportioned. Mesosoma height: greater than width. Dorsal margin of mesosoma, lateral view: convex. Vertical epomial carina: absent. Horizontal epomial carina: absent. Anterior face of pronotum: vertical, largely hidden in dorsal view. Lateral face of pronotum: nearly flat. Netrion: absent. Anterior margin of mesoscutum: anteriorly deflexed, meeting pronotum anteriorly. Skaphion: absent.



Figures 1–6. *Orwellium enigmaticum* gen. n., sp. n. **1** Lateral habitus **2** Head and mesosoma, lateral view **3** Head and mesosoma, dorsal view **4** Head, anterior view **5** Metasoma, dorsal view **6** Fore wing. Scale bars in millimeters. **1–2** Paratype female, OSUC 226498. **3–5** Holotype female, OSUC 163069. **6** specimen sacrificed, not recorded in database.

Shape of mesoscutum in dorsal view: trapezoidal, anterior side curved. Parapsidal lines: absent. Notaulus: present, percurrent. Path of notauli: converging, closely approximated posteriorly. Shape of notaulus: dilated posteriorly. Mesoscutellum shape: slightly wider than long, semicircular. Mesoscutellar armature: absent. Metascutellum shape: not posteriorly produced, present as low convex bulge. Setation of dorsal propodeum: covered by dense, fine pilosity. Lateral propodeal projection: absent, posterior margin of propodeum rounded. Mesal concavity of dorsal propodeum: broadly extending anteriorly to metanotal margin. Median keel of propodeum: absent. Lateral keels of dorsal propodeum: absent. Development of mesopleuron: large, prominent. Mesopleural depression: large, well-developed. Mesopleural carina: present, forming curved arch from near mid coxa to mesopleural pit. Mesopleural pit: present. Anterior margin of ventral mesopleuron: straight, not projecting anteriorly. Mesepimeral foveae: absent. Episternal foveae: present, indicated by arched carina connecting acetabular carina and mesopleural carina. Posterodorsal corner of mesopleuron: rounded. Metapleural triangle: clearly developed, delimited posteriorly by carina. Setation of metapleural triangle: densely, evenly setose. Metapleural pit: not visible, if present, obscured by setation. Posterior margin of metapleuron: produced posteriorly into distinct lamella. Metapleural-propodeal articulation: fused, without suture separating sclerites. Leg shape: gracile, elongate. Posterior surface of hind coxa: transversely rugulose. Trochantellus: present. Tibial setation: with only short setae. Hind tibal longitudinal carina: absent. Tibial spur formula: 1-2-2. Tarsal formula: 5-5-5. Tarsomere shape on hind leg: cylindrical. Pretarsal claws: simple.

Wings: Length of fore wing: extending beyond apex of metasoma. Wing color: hyaline. Shape of fore wing R: weakly arched. Bulla in fore wing R: absent. Fore wing R1: extending to costal margin. Pseudostigma: absent. r-rs shape: reflexed apically. r-rs origin: from R at costal margin, marginal vein therefore present. Development of R1 beyond r-rs: present, therefore postmarginal vein present, short. Fore wing Rs: indicated by darkly pigmented nebulous vein. Fore wing Rs+M (basal vein): indicated by darkly pigmented nebulous vein. Fore wing M: indicated by darkly pigmented nebulous vein. Fore wing Cu: indicated by darkly pigmented nebulous vein. Hind wing R: tracheate throughout length, extending to hamuli on costal margin.

Metasoma: Metasoma shape: short, broad. Relative sizes of metasomal segments: T2 distinctly longest segment. Number of visible terga in female: 7. Number of visible sterna in female: 6. Number of visible terga in male: 7. Number of visible sterna in male: 7. Laterotergites: present, narrow. Laterosternites: present. Base of T1: margined by transverse carina. Crenulate base of terga: T2 only. T1 horn: absent. Microsetae on T6: absent. S1 shape: evenly arched, without distinct median keel. Anterior margin of S1: transverse, not projecting anteriorly. Distribution of felt fields: S2. Cercus: present.

Diagnosis. The large second metasomal segment, by far the largest of all segments (Fig. 5), is also found in members of the subfamilies Platygastrinae and Telenominae. *Orwellium* is distinguished from telenomines by the presence of narrow laterotergites and laterosternites on the metasoma and by the densely setose propodeum and metapleuron. *Orwellium* is distinguished from platygastrines by the presence of well-devel-

oped, tracheate marginal and stigmal veins in the fore wing, the presence of a malar sulcus, and the presence of cerci.

Etymology. The name *Orwellium* honors the author George Orwell, the brilliant and seemingly clairvoyant writer of political science fiction, and is to be considered to be neuter in gender. The specific epithet *enigmaticum* refers to the initial doubts concerning the proper familial placement for this genus.

Link to Distribution Map. [http://osuc.biosci.ohio-state.edu/HymOnline/maplarge.html? id=245120]

Material Examined. Holotype female: **CHILE**: Los Lagos, Ahoni, Chiloé Island, 70 m, V.1988, Malaise trap, L. Masner, OSUC 163069 (deposited in CNCI, Ottawa). *Paratypes*: **CHILE**: 118 males, 159 females, OSUC 163053–163065, 163067–163068, 163070–163071, 226381–226491, 226493–226638, 256958–256960 (CNCI, OSUC).

Discussion. Two outstanding features of *Orwellium* are the number of antennomeres and the dense pilosity on the metapleuron and propodeum. Although we record here that the female antenna is comprised of ten antennomeres, A3 is extremely long and there is a noticeable constriction in its midlength. This seems to indicate the fusion between a former A3 and A4. The densely setose metapleuron and propodeum is relatively rarely seen in Platygastroidea, and then principally within the Platygastrinae. In many specimens of *Orwellium* (such as in Fig. 2), there is an appreciable amount of extraneous material embedded within the setae. This may simply be a trap for debris, or it may suggest the presence of an exocrine gland.

The 1-2-2 tibial spur formula is uncommonly found in the superfamily outside of the Platygastrinae. It is limited to the genera *Archaeoteleia, Neuroscelio,* and the tribe Sparasionini (*sensu* Johnson et al. 2008b). Three sparasionine genera were not included in the analysis of Murphy et al. (2007), but the remainder are precisely those taxa that cluster near Platygastrinae at the base of the cladogram of the superfamily. *Orwellium* has a number of features that are similar to platygastrines. The notauli are expanded posteriorly and converge near the transscutal articulation. *Orwellium* lacks a netrion on the pronotum, the site of origin of the second flexor of the fore wing (Mikó et al. 2007). The mesopleural pit (Fig. 2, *mp*) is located in a relatively low and posterior position on the mesepisternum, and connected by a groove to the apices of the mesopleural carina and sternaulus anteriorly, and to another pit (unnamed in Mikó et al. 2007) located ventrally near the posterior margin of the mesopleuron. Similar structures are found in a number of platygastrines (see illustrations in Masner and Huggert 1989), but are not yet known in the other subfamilies. These similarities to platygastrines must be reconciled with another set of characters. The pronotum lacks the epomial and transverse pronotal carinae. The sex segment in the male is on A5, although the fact that the male has one more segment than platygastrines might suggest that the A5 in *Orwellium* could be homologous with the A4 in platygastrines in which the maximum number of antennomeres is 10. The cerci are well developed on the apical metasomatic tergite, but in platygastrines cerci are completely absent. The presence of the marginal, stigmal and (short) postmarginal vein (Fig. 6) is completely unknown in any platygastrine. We interpret this evidence to be consistent with the hypothesis that *Orwellium* is the sister group of the Platygastrinae.

We are currently actively working on the comprehensive morphological and molecular analysis of relationships within the superfamily that is needed to address this question.

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References

Austin AD, Johnson NF, Dowton M (2005) Systematics, evolution, and biology of scelionid and platygastrid wasps. Annual Review of Entomology 50: 553–582.[4]

Bin F (1981) Definition of female antennal clava based on its plate sensilla in Hymenoptera Scelionidae Telenominae. Redia 64: 245–261.[5]

Early JW, Masner L. Johnson NF (2007) Revision of *Archaeoteleia* Masner (Hymenoptera: Platygastroidea, Scelionidae). Zootaxa 1655: 1–48.[6]

Haliday AH (1833) An essay on the classification of the parasitic Hymenoptera of Britain, which correspond with the Ichneumones minuti of Linnaeus. Entomological Magazine 1: 259– 276.[7]

Haliday AH (1839) Hymenoptera Britannica Oxyura. Fasc. I. Hipploytus Bailliere, London. 16 pp.[8]

Johnson NF, Masner L, Musetti L, van Noort S, Rajmohana K, Darling DC, Guidotti AE, Polaszek A. (2008a) Revision of world species of the genus *Heptascelio* Kieffer (Hymenoptera: Platygastroidea, Platygastridae). Zootaxa 1776: 1–51.[9]

Johnson NF, Masner L, Musetti L (2008b) Review of genera of the tribe Sparasionini (Hymenoptera: Platygastroidea, Scelionidae), and description of two new genera from the New World. American Museum Novitates 3629: 1–24.[10]

Johnson NF, Musetti L, Masner L (2008c) The Cretaceous scelionid genus *Proteroscelio* Brues (Hymenoptera: Platygastroidea). American Museum Novitates 3603: 1–7.[11]

Masner L (1980) Key to genera of Scelionidae of the Holarctic region, with descriptions of new genera and species (Hymenoptera: Proctotrupoidea). Memoirs of the Entomological Society of Canada 113: 1–54.[12]

Masner L (1993) Superfamily Platygastroidea. In: Goulet H, Huber JT (Eds) Hymenoptera of the world: an identification guide to families. Research Branch, Agriculture Canada Publication 1894/E, 558–565.[13]

Masner L (1995) The proctotrupoid families. In: Hanson P, Gauld ID (Eds) Hymenoptera of Costa Rica. Oxford University Press, Oxford, 209–245.[14]

Masner L, Huggert L (1989) World review and keys to genera of the subfamily Inostemmatinae with reassignment of the taxa to the Platygastrinae and Sceliotrachelinae (Hymenoptera: Platygastridae). Memoirs of the Entomological Society of Canada 147: 1–214.[15]

Mikó I, Vilhelmsen L, Johnson NF, Masner L, Pénzes Z. (2007) Skeletomusculature of Scelionidae (Hymenoptera: Platygastroidea): head and mesosoma. Zootaxa 1571: 1–78.[16]

Murphy NP, Carey D, Castro LR, Dowton M, Austin AD (2007) Phylogeny of the platygastroid wasps (Hymenoptera) based on sequences from the 18S rRNA, 28S rRNA and cytochrome oxidase I genes: implications for evolution of the ovipositor system and host relationships. Biological Journal of the Linnean Society 91: 653–669.[17]

Polaszek A, Agosti D, Alonso-Zarazaga M, Beccaloni G, de Place Bjørn P, et al. (2005) A universal register for animal names. Nature 437: 477.[18]

Pyle RL, Earle JL, Greene BD (2008) Five new species of the damselfish genus *Chromis* (Perciformes: Labroidei:Pomacentridae) from deep coral reefs in the tropical western Pacific. Zootaxa 1671: 3–31.[19]

Sharkey MJ (2007) Phylogeny and classification of Hymenoptera. Zootaxa 1668: 521–548.[20]

Endnotes

1 http://biocol.org/urn:lsid:biocol.org:col:1012
2 http://biocol.org/urn:lsid:biocol.org:col:1014
3 http://www.morphbank.net/?id=473677
4 http://lsid.tdwg.org/urn:lsid:biosci.ohio-state.edu:osuc_pubs:21201
5 http://lsid.tdwg.org/urn:lsid:biosci.ohio-state.edu:osuc_pubs:131
6 http://lsid.tdwg.org/urn:lsid:biosci.ohio-state.edu:osuc_pubs:21337
7 http://lsid.tdwg.org/urn:lsid:biosci.ohio-state.edu:osuc_pubs:370
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